# AUTOMATIC ACTIVATION OF TOUCH SENSITIVE
# SCREEN IN A HAND HELD COMPUTING DEVICE

Field of the Invention

5         This invention relates to control of operation of a touch sensitive screen for

a portable hand held computing device.

Background of the Invention

Hand held computing devices, such as personal digital assistants ("PDAs")

and radiotelephones (collectively referred to as "hand held devices"), have widely

10     adopted touch sensitive screen panels ("touch screens"), overlaid on a display

screen, such as a liquid crystal display ("LCD"). A touch screen serves as a

data/command input mechanism so that, when a user employs a stylus to touch a

touch screen at a selected location, the position of the selected location, alone or

relative to the display screen, is identified and processed by a signal processor or

15     its equivalent circuit(s) resident on the hand held device.

A conventional hand held device automatically activates an associated

touch screen upon power-up, with the touch screen remaining activated until an

explicit power-down. Alternatively, the device deactivates the touch screen by

measuring accumulated idle time (usually measured in minutes) since the touch

20     screen was last touched, using a time-out mechanism. Reactivating a touch screen

from a deactivated state is performed by pressing one or more keys, such as a

power key or other designated key. Some radiotelephones that are equipped with

touch screens also activate or deactivate an associated touch screen through flip

of a keypad hinged on the device housing so that the touch screen (1) is in an

25     activated mode when the keypad is opened and (2) is in a deactivated mode when

the keypad is closed. A conventional hand held device with only a time-out

mechanism does not provide adequate protection from accidental activation of the

associated touch screen before time-out occurs, through accidental pressing or

touching of an activation mechanism while the device is carried in the user's

5      pocket, pocketbook, briefcase or similar container. A time-out mechanism

consumes additional battery power, when the device is not in use. Although a

hand held device with a flip keypad or a protective cover can prevent accidental

activation and can provide some power conservation, a hand held device without

a flip keypad or a protective cover cannot.

10           What is needed is a automatic activation and deactivation mechanism for a

touch screen that prevents accidental activation of touch screen components and

that conserves battery power by monitoring more closely the present state of the

hand held device. Preferably, the activation and deactivation mechanism should

be flexible enough to rely on one or on a plurality of state monitoring approaches.

15     Summary of the Invention

These needs are met by the invention, which provides a mechanism for

activating and deactivating selected touch screen components by detecting

whether a stylus associated with the touch screen is present in, or as been

removed from, a stylus receiving receptacle, such as a stylus slot. Detection of the

20     presence or absence of the stylus in the receptacle is determined by employing

one or more mechanical and/or electrical sensors or switches and comparing a

value provided by such a sensor with a reference value, corresponding to presence

(or absence) of the stylus in the receptacle. Two or more different sensors can be

used to provide a more reliable assessment of the presence or absence of the

25     stylus in the receptacle. A programmable time-out mechanism is optionally

provided to deactivate touch screen components when the touch screen itself has

not been used for an accumulation time interval having a selected time-out

interval value. Accumulation of this time is optionally terminated whenever the

system enters or re-enters an "active" state, during which the touch screen is used

5        the (optional) key pad is used and/or the device receives a communication from a

signal source spaced apart from the device.

Brief Description of the Drawings

Figure 1 is a perspective view of a hand held device constructed according

to the invention.

10        Figure 2 is a flow chart of a procedure for practising the invention.

Description of Best Modes of the Invention

Figure 1 illustrates practice of the invention in one embodiment. A hand

held electronics device 11, according to the invention, includes a touch screen 13,

including an associated display screen 14, an optional keypad 15, an electronic

15        signal processing module (including a power conservation module and a time

accumulation module) 17, a stylus receptacle (slot or other stylus-receiving site on

the device 11) 19, a selected stylus 21 and a stylus sensor 23 that communicates

with the signal processing module 17.

When the stylus sensor 23 senses that the stylus 21 is present in the stylus

20        receptacle 19, the stylus sensor provides a first stylus signal for the signal

processing module 17 that results in one or more of the following three actions:

(1) the display screen 14 is deactivated or turned off; (2) electronics that control

response of the touch screen 13 is (partly or fully) turned off or deactivated; and

(3) a power conservation system, controlled by the signal processing module 17,

25        is activated or turned on. When the stylus sensor 23 senses that the stylus 21 is not

present in the stylus receptacle 19, the stylus sensor provides a second stylus signal for the signal processing module 17 that results in one or more of the following three actions: (1) the display screen 14 is activated; (2) electronics that control response of the touch screen 13 is activated; (3) a power conservation system, controlled by the signal processing module 17, is deactivated.

The stylus sensor 23 senses the presence or absence of the stylus 21 in the stylus receptacle 19 by one or more of the following procedures:

(1) an impedance for the stylus receptacle 19 (with or without the stylus being present) is measured, and the measured impedance value is compared with at least one of (i) a first impedance value $Z1$ corresponding to presence of the stylus 21 in the stylus receptacle 19 and (ii) a second impedance value $Z2$ corresponding to absence of the stylus 21 in the stylus receptacle 19;

(2) an electrical conductivity for the stylus receptacle 19 (with or without the stylus being present) is measured and compared with at least one of: (iii) a first conductivity value $g1$ corresponding to the presence of the stylus 21 in the stylus receptacle 19 and (iv) a second conductivity value $g2$ corresponding to absence off the stylus 21 in the receptacle 19;

(3) an electrical capacitance (or associated dielectric value) for the stylus receptacle 19 (with or without the stylus being present) is measured and compared with at least one of: (iii) a first capacitance value $C1$ corresponding to the presence of the stylus 21 in the stylus receptacle 19 and (iv) a second capacitance value $C2$ corresponding to absence off the stylus 21 in the receptacle 19;

(4) a mass associated with the receptacle 21 is measured and compared with at least one of (v) a first mass value $m1$ corresponding to the presence of the stylus 21 in the stylus receptacle 19 and (vi) a second mass value $m2$

corresponding to absence off the stylus 21 in the receptacle 19;

(5) an electromechanical switch, such as a mercury switch or similar switch, associated with the receptacle 21 to sense the presence of the stylus and enter a first state, and to sense the absence of the stylus and enter a second state;

5         (6) an electromagnetic sensor, such as a Hall effect proximity sensor, that senses proximity, or absence of proximity, of a ferromagnetic component embedded in the stylus; and

(7) an electro-optical sensor that issues light in a selected wavelength range and receives and senses light in this range reflected from a light-reflecting

10      component embedded in the stylus, when the stylus is present in the receptacle, or when the stylus is absent from the receptacle.

Other comparison tests can also be used for determining whether the stylus is present in or absent from the receptacle. Preferably, more than one comparison test is used for such purpose. For example, two tests (e.g., tests number 1 and 4)

15      may be applied and the result of each test compared. If both tests indicate that the stylus is present, or both tests indicate that the stylus is absent, the common result of the tests is accepted. If the two tests indicate opposite results, a third test (e.g., test number 2) is applied, and the test result indicated by at least two of the tests is accepted as the conclusion, using majority voting.

20      Figure 2 is a flow chart of a procedure for practising the invention. In step 31, a stylus sensor determines if the stylus is present in the stylus receptacle, using one or more of the comparison tests discussed in the preceding. If the answer to the query in step 31 is "yes," the system moves to step 33 and takes one or more of the following first set of actions: (1) the display screen 14 is deactivated or

25      turned off (if not already off); (2) electronics that control response of the touch

screen 13 is (partly or fully) turned off or deactivated (if not already off); and (3) a power conservation system, controlled by the signal processing module 17, is activated or turned on (if not already on). The system then returns to step 31.

If the answer to the query in step 31 is "no," the system moves to step 35 and determines if the system is in an "active" state. The system is in an "active" state if: (1) the touch screen is being used, (2) a keypad (optional) is being used, (3) the device is receiving a communication from a signal source spaced apart from the device. If the answer to the query in step 35 is "yes," the system moves to step 37 and takes at least one of the following second set of actions: (1) the display screen 14 is activated (if not already on); (2) electronics that control response of the touch screen 13 is activated (if not already on); (3) a power conservation system, controlled by the signal processing module 17, is deactivated (if not already off). The system then returns to step 31.

If the answer to the query in step 35 is "no," the system moves to step 39 (optional) and determines an accumulated time $\Delta$ t(accum) during which the device has never been in an active state. In step 41 (optional), the system determines if the accumulated time $\Delta$ t(accum) is greater than a selected accumulation time $\Delta$ t(time-out). If the answer to the query in step 41 is "yes," the system moves to step 33, takes at least one of the first set of actions, and returns to step 31. If the answer to the query in step 41 is "no," the system moves to step 37, takes at least one of the second set of actions and returns to step 31.